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Peter S. Schmidt*
Center for Corporate Responsibility and Sustainability (CCRS), University of Zurich
Therese Werner†
Center of Economic Research, Swiss Federal Institute of Technology (ETH) Zurich

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Abstract

Empirical studies on the relation of the European Union Emissions Trading Scheme (EU ETS) and its impact on stock prices of affected companies concentrate so far mostly on the mechanism between emissions allowance (EUA) price and stock returns. This study in contrast examines the relation of stock returns and the announcement on verified emissions (VE). We use event study methodology and find on the 15^{th} of May 2006, the first time when allocation could be justified, a negative cumulated and significant impact of the announcement of VE on stock returns and a positive cumulated (and marginal significant) impact on the 28^{th} of April 2008, the last announcement of VE in the first period. Using the results from the event-study for cross sectional analysis we find evidence for a change in how announcements on VE were incorporated in stock markets.

Keywords: Event study; EU ETS

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*Address: University of Zurich (Center for Corporate Responsibility and Sustainability) Künstlergasse 15a, CH-8001 Zurich, Switzerland, e-mail: *peter.schmidt@ccrs.uzh.ch*

†Address: CER-ETH – Center of Economic Research at ETH Zurich, ZUE F 14, CH-8092 Zurich, Switzerland, e-mail: *twerner@ethz.ch*

1 Introduction

There is widespread consensus on the fact that the climate is changing because of anthropogenic greenhouse gas (GHG) emissions and that worldwide effort is needed to fight the subsequent negative consequences. The consensus on the instruments and their impacts on other issues as for example development or economic prosperity however is not that broad. We analyze how the implementation of the EU ETS affected the involved firms' stock returns.

Under the Kyoto Protocol, adopted in 1997, the European Community decided to cut its GHG emissions by overall 8% between 2008 and 2012 relatively to 1990 levels. Even before the ratification of the Kyoto Protocol the EU intended to launch an emissions trading scheme to gain experience, as a global trading system was expected to be introduced in 2008.[1] Generally the implementation of an emission trading scheme can have different impacts: i) it forms an additional cost to the producing firm; ii) it increases the absolute competitiveness by enforced efficiency gains (Porter and van der Linde, 1995) and iii) when the permits are allocated for free (grandfathered), the firm maintains a valuable asset. These effects work in different directions and are supposed to occur in varying intensity for countries, sectors and points in time.

Pricing CO_2 has a negative affect on a firms' production costs, however also on those from the competitors and according to a firms' possibility to pass on those additional costs to the consumers its relative market power can gain or lose.[2] Furthermore a change in the asset-wealth a firm is holding also changes its profit opportunity (either by a change of the permits price or by a change in the amount of allowances distributed on the whole market or used for production).

In 2003 the basic conditions of the European market for emission allowances (EUA) were agreed on, where one allowance gives right to emit one tone of CO_2. In the first phase of the EU ETS emissions permits were predominantly grandfathered to the affected firms by allocation mechanisms formed by the particular politicians. During the three years of the first period firms could bank and borrow within the years, however no exchange with the later periods was allowed, so that the first period was a self-contained market unaffected by future caps.

We expect to find positive as well as negative abnormal returns as a reaction on the general information about the shortage of the EUA market. The announcement of the effective emissions then gives additional information in the sense that more about the true amount of emissions needed is learnt and

[1] See the Green Paper on greenhouse gas emissions trading within the European Union (EC, 2000).

[2] See on this topic Salop and Scheffman (1983), Hahn (1984), Misiolek and Elder (1989) or Antelo and Bru (2009).

investors can correct their believes about the used technologies and applied abatement possibilities of the individual firms.

2 Literature overview

Relating to the EUA several studies evaluate the efficiency of the introduced environmental policy. In a brief overview of the existing literature we concentrate on the studies concerning the individual firms and the development of the EUA price in the first period.

Focusing on the competitive situation and its change Demailly and Quirion (2008) do not find any evidence for a negative effect on the competitiveness from emissions trading for the iron and steel industry, a sector that is strongly exposed to competition from outside of the EU. In their cross-country analysis they find rather high evidence for a moderate cost pass-through and therefore conclude that concerns about the competitive situation is no reasons not to tighten the cap in the second period. Sijm et al. (2006) test empirically if price change in the permit prices are passed through on the end prices and find strong evidence for so called windfall profits for German and Dutch electricity producers and conclude that firms with market power can profit from regulation if the permits are grandfathered. The free allocation of emission allowances then mainly give the respective firm an additional income opportunity.

As the price of an emission permit has become an important input factor in production for the firms covered by the EU ETS, several studies focus on the development of its price. Before the start of the EU ETS Christiansen et al. (2005) propose, by reviewing other emission markets, that the permit prices will be mainly driven by policy and regulatory issues, market fundamentals as economic growth, temperature development and by technical indicators. Alberola et al. (2009) inspect the price development in the first phase of the EU ETS and at the start of the second phase. They find that the market for tradable permits is highly sensitive to the ratio between the overall cap and the needed certificates. Interestingly they find evidence for a high degree of heterogeneity in the agents' anticipations, what might be explained by the lack of experience of EUA traders. Ellerman and Buchner (2008) take a first look at the allocation data and analyze sectoral and country specific allocation differences and derives some first conclusions about the impact on the permit prices. Using event-study methodology Mansanet-Bataller and Pardo (2007) analyze the effect of official announcements from the EU Commission concerning the EU ETS on permit prices and find a general sensitivity of permit prices to such announcements.

Hintermann (2010) as well as Montagnoli and de Vries (2010) find evidence that the market for EUAs in the first part of phase I was not efficient. Hintermann (2010) divides phase I into two peri-

ods: before April 2006 and from April 2006 on, because of the significant price drop of EUAs in late April 2006. He sets up an economic model which seeks to explain the EUA price evolution with economic fundamentals.[3] The results are that, in the pre-crash period, EUA prices are rarely explained by economic fundamentals, whereas in the post-crash period the EUA prices are well explained by market fundamentals. He concludes that this is due to a lack of market efficiency in the pre-crash period. Montagnoli and de Vries (2010) use several variance ratio tests to check the Efficient Market Hypothesis (EMH) on the EUA prices. Their results suggest that the EMH holds in the phase II period whereas it does not hold in phase I. Interestingly they find some support (albeit weaker than for phase II) that the EMH holds also in the post-crash period, which also supports the findings of Hintermann (2010).

Oberndorfer (2009) and Veith et al. (2009) examine the relation between stock returns of corporations of the European power sector and returns of EUAs. They both find that stock returns of electricity producers and EUA prices are generally positively related. This means that the permits are mostly seen as an asset the respective firm holds and not necessarily as a cost factor.

To our best knowledge the only event study relating corporate stock returns to EU ETS events of the first period so far is Bushnell et al. (2009). They conduct an event study to detect the impact of the permit price crash in late April 2006 on 90 firms covered by the EU ETS. They find evidence for sector specific reaction on permit price changes and a positive relationship between permit price drop and the stock returns and conclude that the market mainly sees permits as an asset.

In this paper we want to combine this two approaches and first conduct an event study for six VE events and then accomplish cross sectional estimations to find the fundamentals of abnormal returns for each point in time.

3 Hypothesis

3.1 Regulation and performance

The introduction of an environmental regulation internalizes the before external effect and producing by emitting CO_2 gets costly. In the first phase from 2005 until the end of 2007 the permits were mostly allocated to the respective firms for free, so that only a difference in the amount of needed permits versus the amount of freely allocated allowances affected a firms' expected return relative to the unregulated

[3] Hintermann (2010) develops a model which is based on the idea that the optimal amount of abatement is a function of allowance prices and fundamental variables like temperature, precipitation, Nordic reservoir levels, stock market conditions and other influences. The empirical implementation of this model regresses permit price changes on changes of the aforementioned variables. For details see Hintermann (2010).

situation. A divergence however between the amount of allocated EUAs and the needed ones was very likely. The allocation of the permits were fix for a three years time period. But the need depend on several more or less variable and uncertain parameters as the development of the demand and the change in abatement possibilities.[4] The biggest possible mismatch between the freely distributed and the needed amount of permits however changes in value with the overall need for permits.[5] For the respective firms there are then two possible effects on their expected returns if verified emissions do not correspond to allocated EUAs:

- *Change in the asset value*: any long (short) position in permits, gains (loses) value with a raise (drop) in permit prices and increases (lower) a firms' expected profit;
- *Change in production cost*: production costs change with the price of the EUA, a higher (lower) permit price shifts production costs upward (downwards) and lower (increase) a firms' expected profit.

The first effect depends on the change in permit prices (market effect), the second on the firms net endowments with permits (abatement effect). How strong this effect is for a certain firm definitely depends on the intensity of CO_2 in the production process or how big the share of costs related to emissions permits is relative to the other input factors.

We want to identify the total effect of news about verified emissions on the respective firms' performance. These changes in a firms' expected profit are supposed to be incorporated into the stock market as investors update their expectations so that so-called "abnormal returns" occur.

Match of allocation In the beginning of 2006/2007/2008 and 2009 respectively the CITL published the amount the firms had emitted in the past year. Looking at these four events we expect to see an adjustment in the stock prices for those firms with a distinct over- respectively under-allocation. Especially in May 2006 investors could verify if the permits were appropriately allocated or not. Firms with a distinct over-allocation are supposed to show a positive abnormal return (and a negative one for firms short in allocations), as their profit expectations gained an additional component. The firms are supposed to be able to gain additional benefits from selling its' spare permits, the firms lacking permits need to buy additional permits and therefore a negative abnormal return is expected.

[4]Natural gas is seen as one of the main abatement possibilities (switch from electricity production with coal or oil to CO_2 extensive gas (Oberndorfer, 2009)), then the mark-up in price denotes the (variable) abatement cost.

[5]According to Mansanet-Bataller and Pardo (2007) and Conrad et al. (2010) the price for allowances depend on macroeconomic factors, institutional changes and gas prices.

Preliminary information The two events reflecting preliminary information about the emissions are not supposed to show much individual reaction to the update as the details are not announced then. Industries that are supposed to be long in allowances possibly lose from the drastic devaluation of the permits in late April 2006. Especially for the electricity market and the iron and steel industry we expect to find the same results as Oberndorfer (2009); Demailly and Quirion (2008) that find a positive relationship between the permit prices and the respective stock prices.

3.2 Cumulated abnormal returns

In traditional event-studies the standardized abnormal returns from the individual firms that are affected by an event are cumulated to make a statement about how much the specific event influences the stock market returns.

Positive cumulated abnormal return can occur when the permits market happen to be less tight than expected by the investors. The firms have a lower additional marginal emissions cost and therefore the expected return rises (this would correspond with a general over-allocation). The same effect appear when the firms "over-abated" and the regulation lead to efficiency enhancing investments, that not only reduced the emissions intensity of production but also upgraded the general competitional situation.[6] Without a change of the production costs, an update of the expected returns is needed, when the firms realize windfall profits.[7] That means that the costs of the EUAs can be more than shifted on to the customers.

Negative cumulated abnormal return occur analogue to positive cumulated abnormal returns when the firms publish surprisingly high VE values. The investors downgrade their expectations and negative abnormal returns can be observed. The costs of production rises and a negative cumulated abnormal return is likely.

No cumulated abnormal return are seen when the majority of the stock returns do not react in the same direction. When there exist significant differences, either on a country-, sectoral- or even firm-specific level we expect no cumulated abnormal return as diverging effects compensate for each others. A second possibility for no cumulated abnormal returns is when the event does not include any relevant new information, so that no abnormal return occure at all.

[6] For a discussion between over-allocation and abatement see Ellerman and Buchner (2008).
[7] See Veith et al. (2009) and Sijm et al. (2006).

3.3 Individual abnormal returns

Especially for the events when the firms announce their VE individual reactions of their stock market returns are likely. Firms that invest in abatement technology and by that could reduce their emissions, can profit from their resulting over-allocation. Not only that spare permits can be sold but if the Porter hypothesis (Porter and van der Linde, 1995) applies, investors update their profit expectation because of an enhanced competitive situation. For firms with a distinct under-allocation however the investors are suppose to downgrade their profit expectation and we expect to see negative abnormal returns. For both situation the effect is strongest for the first time the market learns about a systematic over- respectively under-allocation.

4 Data

Our estimations are based on the information from the Community Independent Transaction Log (CITL) about all installations covered by the EU ETS. The installations were then grouped on the firm level[8] and matched with the financial data from Thomson Reuters Datastream. In total we were able to identify 206 quoted stock companies from Austria, Denmark, Germany and the UK that have installations covered by the EU ETS.

We use following event dates: 25/04/2006 when preliminary information on VE 2005 from many countries leaked into the market; 15/05/2006 when VE 2005 from all installations were published by the CITL; 02/04/2007 when preliminary information on VE 2006 from many countries leaked into the market; 08/05/2007 when VE 2006 from all installations were published by the CITL; 28/05/2008 when VE 2007 from all installations were published by the CITL and 31/03/2009 when VE for 2008 were published, the first year of the second compliance period. For the particular estinations however we used substantially smaller samples as we controlled for confounding effects in the event window from day -3 to 3.[9] As our considered events were all in March, April or May, many firms had to be excluded because they reported information in their annual financial accounting that was not incorporated in the respective stock prices yet. Furthermore, to control for sufficient liquidity of the stock; we impose minimum requirements related to the trading behavior of the respective stocks in the estimation and

[8] We assume that reallocation of permits within a firm is cost-free.

[9] We checked the main newspapers on LexisNexis of the respective country to ensure that no other unforeseeable event leads to a jump in the stock prices (see McWilliams and Siegel, 1997). Such confounding events can be earnings announcements, restructuring announcements, changes in analyst reports or similar events. News related to the EU ETS are not considered as confounding events.

event window. More specific: stocks that had not been traded (that means we observe a price change) on at least 60 % of all days, excluding holidays and stocks without a price change on more than ten successive days were not included.

For the cross sectional analysis we furthermore use information from the CITL on allowances, and VE (accumulated for the respective firms). As mentioned in Trotignion and Delbosc (2008) it is difficult to properly determine the activity of an installation and even more the sectoral affiliation of a firm as the link between the installations which get the allowances and has to report it's emissions is the firm, which is the market participant. For the empirical estimations we therefore use the sectoral assignment of Thomson Reuters Datastream.[10]

5 Methodology

We use the event study approach to test our hypotheses as it is frequently used in empirical finance and empirical environmental economics (e.g. Bushnell et al., 2009; Edmans et al., 2007; Linn, 2010; Miclaus et al., 2008). To apply this approach typically efficient financial markets are assumed (see McWilliams and Siegel, 1997, p.630), which seems to be justified in most applications[11] There exist situations however, where information is only gradually incorporated into the market. A prominent example is the so-called post-announcement drift (see Asquith (1983) or Jensen and Ruback (1983) in the case of merger announcements and Bernard and Thomas (1989) or Mendenhall (2004) in the case of earnings announcements). To deal with this issue long-run event study approaches are employed (e.g. Kothari and Warner, 2007, sec. 4). In contrast to long-run approaches, we use a short-run approach and assume that information is incorporated into the market within a few days.[12] We use the following factor model to describe daily stock returns:

$$\begin{aligned} R_{it} = \alpha_i + \beta_i^{\mathrm{M}} \cdot R_t^{\mathrm{M}} + \beta_i^{\mathrm{SMB}} \cdot R_t^{\mathrm{SMB}} + \beta_i^{\mathrm{HML}} \cdot R_t^{\mathrm{HML}} + \beta_i^{\mathrm{C}} \cdot R_t^{\mathrm{C}} + \beta_i^{\mathrm{O}} \cdot R_t^{\mathrm{O}} + \beta_i^{\mathrm{G}} \cdot R_t^{\mathrm{G}} \\ + \beta_i^{\mathrm{E}} \cdot R_t^{\mathrm{E}} + \beta_i^{\mathrm{Ex}} \cdot R_t^{\mathrm{Ex}} + \varepsilon_{it} \end{aligned} \tag{1}$$

where R_{it} is the return in excess of the risk free rate of stock i, R_t^{M} is the return of the market portfolio in excess of the risk free rate, R_t^{SMB} is the return of a portfolio which is long in small stocks and short in

[10] The activity assigned to the installation by the CITL, what is the base for most studies about sectoral effects of the EU ETS are not directly comparable, however as we are interested in the effect on listed firms the use of the Thomson Reuters Datastream information is a reasonable choice.

[11] (e.g. Fama, 1991, p. 1602) in generall and for our application Hintermann (2010); Montagnoli and de Vries (2010).

[12] We assume in the present application that the information is incorporated into the market in the period that begins three days before the event date and ends three days after the event date. We therefore do not assume that information is incorporated immediately into the market, but with a delay of a few days.

big stocks, R_t^{HML} is the return of a portfolio which is long in value stocks and short in growth stocks, R_t^{C} is the return of the emission certificate spot or future price in excess of the risk free rate, R_t^{O} is the return of the oil forward price in excess of the risk free rate, R_t^{G} is the return of the gas forward price in excess of the risk free rate, R_t^{E} is the return of the electricity future price in excess of the risk free rate, and R_t^{Ex} is the return of the forward dollar exchange rate of the domestic currency in excess of the risk free rate in time t respectively. $\beta_i^{\mathrm{M}}, \beta_i^{\mathrm{SMB}}, \beta_i^{\mathrm{HML}}, \beta_i^{\mathrm{C}}, \beta_i^{\mathrm{O}}, \beta_i^{\mathrm{G}}, \beta_i^{\mathrm{E}}$ and β_i^{Ex} are the factor sensitivities of stock i to the respective factors. We also include the constant α_i to account for systematical over- or underperformance which is unrelated to the risk factors. ε_{it} is an error term with expectation zero, a constant variance and no serial correlation.

Most event studies employ the one factor model based on the CAPM which incorporates the market factor (R_t^{M}) only. We use a different model for two reasons. First, since we examine events which occur to all firms at the same time, cross sectional correlation might be a serious problem. Kolari and Pynnönen (2010) show that by adding the Fama-French factors (see Fama and French (1993)) to the one factor model, the cross sectional correlation of the error terms of the individual stocks is drastically reduced. Second, the price evolution of emission certificates, oil, gas and electricity are likely to be linked to stock prices (e.g. Oberndorfer, 2009; Veith et al., 2009). To control for these possible impacts on stock prices we also include return series of emission certificates, oil, gas and electricity (either based on the spot prices or on the future/forward prices).

Based on the model in eq. (1) we estimate abnormal returns. We define the time index t in event time. That means $t = 0$ is the day on which the event took place, $t = -1$ is one day before the event, $t = 1$ one day after the event and so forth. We estimate the model in eq. (1) over the period $-L - 9$ to -9.[13] We define the abnormal return of stock i as:

$$ar_{it} = R_t^i - \hat{R}_t^i \tag{2}$$

where $\hat{R}_t^i$ is the fitted value of R_t^i based on eq. (1) with estimated parameters from data of the last $-L - 9$ to -9 days. The abnormal returns are estimated according to eq. (2) for all days of the so-called event window which ranges from day -3 to day 3. We also calculate scaled cumulative abnormal returns

[13] In our present application L is either 175, 190 or 200 depending on the availability of the emission certificate spot and future series.

over various time intervals:

$$scar_i^{t_1,t_2} = \frac{\sum_{t=t_1}^{t_2} ar_i}{s_i}, \tag{3}$$

where s_i is an estimate of the variance of the cumulative abnormal returns[14] and $t_1 = -3, -1$ or 0 and $t_2 = 1$ or 3. To asses the impact of the event in general we calculate average scaled cumulative abnormal returns over all firms affected by the event:

$$ascar^{t_1,t_2} = \sum_{i=1}^{N} scar_i^{t_1,t_2} \tag{4}$$

where N is the total number of affected firms.

To conduct inferences whether the event in question has an impact on stock returns (or not), we calculate the following statistic proposed by Kolari and Pynnönen (2010):

$$t_{AB} = \frac{ascar^{t_1,t_2} \cdot \sqrt{N}}{s_A \sqrt{1 + (N-1)\bar{r}}} \tag{5}$$

where s_A is the square root of a feasible estimator of the abnormal return variance and $\bar{r}$ is the average of the sample cross-correlations of the estimation-period residuals.[15]. This statistic is an adjustment of t statistic proposed by Boehmer et al. (1991) (adjusted Boehmer, Musumeci, and Poulsen (AB)).

6 Results

6.1 Event study

To implement the event study approach described in section 5 we use the following settings. We chose the length of the estimation window to be $L = 175$ for 25/04/2006, $L = 190$ for 15/05/2006 and $L = 200$ for the other dates. We report results for the following event windows: Three days before the event to three days after the event ([-3,3]); three days before the event to one days after the event ([-3,1]); one day before the event to one day after the event ([-1,1]); one day before the event to three days after the event ([-1,3]) and the event date itself ([0]). We include firms if we are able to match firms on the CITL with valid firm data from Thomson Reuters Datastream, besides the requirements outlined in section 4. We

[14]For details see Kolari and Pynnönen (2010) or Campbell et al. (1997)

[15]For details see Kolari and Pynnönen (2010)

use market and Fama-French factors on the country level and all additional factors for all countries, since they are not assumed to be country-specific. It is a well established result in the asset pricing literature that local factors provide a better description of average returns than global factors (see Griffin, 2002; Fama and French, 2011). In the event study literature it is also well-known that local factors provide accurate inferences (e.g. Campbell et al., 2010). Therefore we use local market and local Fama-French factors. All returns are denominated in euro values. Furthermore we use so called lumped return, which means that a zero return is obtained if there is no trade.[16]

[Insert table 1 here]

Panel B of table 1 shows the cumulated abnormal returns for the CITL published VE of 2005. For all estimation windows we find significant negative cumulated abnormal returns. After the sharp price drop in late April, when the market learned about the articulate over-allocation, the detailed announcement on VE on a firm base then led to a stabilization of the EUA prices and gave investors new information about the individual firms' situations. The negative cumulated abnormal returns corresponds to the hypothesis that investors downgraded their expectations about the firms' future profits because of higher production costs.

In panel E of table 1 we find significant positive cumulated abnormal returns on the event day ([0]) and for the event window [-3,1]. Different from the second event in May 2008 the prices for the first period EUAs was almost zero, so not the direct value or cost from 2007s emissions and respective allocation was evaluated. We rather assume that the VE were evaluated with respect to period IIs' allocation, even though this permits could not be used for compliance before one year later. This means that the fact that VE for the analyzed firms was lower than the year before lead to this positive update of future return expectations.

For the last event shown in panel F of table 1 significant positive cumulated results for the two event windows [-1,1] and [-1,3]. Confirming the results of panel E this positive cumulated returns show the perverse effect that higher verified emissions are seen as a positive signal by investors.

All other announcements about VEs show no significant abnormal returns (panels A, C and D).

[16] Campbell et al. (2010); Bartholdy et al. (2007) suggest that trade-to-trade returns are used, but also show that the difference between trade-to-trade and lumped returns is rather small.

6.2 Cross sectional analysis

For the cross sectional analysis we run univariate and multivariate regressions for the six events. Since our sample size is rather small,[17] we apply a wild bootstrap procedure to obtain reliable inferences. It is well known that bootstrap inference provides asymptotic refinements.[18] We implement the wild bootstrap based on the recommendations of Flachaire (2005) and estimate the following regression relationship:

$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_3 \cdot \text{VE}_i + b_4 \cdot \text{OA}_i + b_5 \cdot \text{CD}_i + e_i, \tag{6}$$

where $scar_i^{t_1,t_2}$ are the standardized cumulated abnormal returns estimated in the event study (see equation 3) of firm i. Sales_i are the sales of firm i in the previous year, MtBv_i is the Market to Book value of firm i based on the preceding December, VE_i are the verified emission which are expected to be published at the time the event takes place, OA_i is the over-allocation with respect to the published VE and CD_i is a country dummy which is one for firms located in Denmark or the UK. Sales_i, MtBv_i and VE_i are in logarithms. We exclude all observations where VE or allowances are zero. We do neither assume that the error term is symmetric nor that it is homoskedastic distributed. However, we do assume that the error term is not serially correlated. We estimate equation 6 for $[t_1, t_2]$ pairs [-3,3], [-3,1], [-1,1], [-1,3] and [0,0]. Besides the multivariate regression 6 we also report univariate regression results (including a constant) with VE and over-allocation as the dependent variable. For event dates after 2006 we add the change in logarithmic VE for each firm (ChVE_i) to equation 6 and perform an additional univariate regression with change in VE as independent variable.

For the 25/04/2006, when investors learned that the market was long in EUAs we find significant positive effects from over-allocation (see table 2), especially for the event windows that start before the 25/04/2006 - the date that has been verified as the date when the market learned that there was general over-allocation and the EUA price dropped by nearly two third. Possibly some firms even informed the public about their over-allocation before the countries and the CITL could do so. Note that the overall effect of the event study results in section 6.1 (see also table 1) does not show a significant positive effect for all firms. However we observe significant positive individual abnormal returns for some firms. Thus the cross sectional analysis suggests that these positive abnormal returns might be firms which are over-allocated with EUAs. Firms recognizing their over-allocation could sell the not needed permits and

[17] 59 firms for the 25/04/2006, 53 for the 15/05/2006, 60 for the 02/04/2007, 45 for the 08/05/2007, 57 firms for the 28/05/2008 and 54 firms for the 31/03/2009.

[18] We do not assume that the error term is symmetrically distributed. Hence the rate of convergence of the error in the rejection probabilities is $n^{-1/2}$ (see Flachaire, 2005, p. 365).

could realize profits before the EUA price drop.

[Insert table 2 here]

When the 2005 VE were announced on 15/05/2006 we find mainly negative effects from VE and over-allocation for the estimations of cumulated abnormal return for the reported specifications and event windows (see table 3). The correlation in table 2 is reversed for the second event and gives a rather inconclusive picture of the reaction on the individual firm's announcements on VE. Although the event study study results of section 6.1 reports significant negative cumulated abnormal returns, we are not able to explain it with the specification of equation 6.

[Insert table 3 here]

The results for the third event (02/04/2007) shows robust significant positive effects for VE when the event window includes the three days after the announcement. This rather counterintuitive result might possibly be explained by the ongoing discussion about the allocation for the second compliance phase starting in 2008, for that the countries needed to enter the national allocation plans by the end of June 2006. As the VE of 2005 and 2006 served as a base for allocation in the second compliance period a higher amount of VE 2006 was obviously seen as a indicator for a higher allocation in period II. Furthermore these firms might still have relatively cheap abatement possibilities.

[Insert table 4 here]

The result seen in table 5 for the preliminary information about VE is supported by the regression on abnormal returns on the detailed announcement from the CITL on the 08/05/2007. As can be seen in table 5 the change in VE[19] negatively affect abnormal returns. Given that a positive change in VE means that the respective firm shows growth in emissions, markets might expect enlarged pressure for abatement for the respective firms.

[Insert table 5 here]

The abnormal returns for the event 28/05/2008 do not significantly depend on any of the tested variables. Only the country dummy seems to explain some of the variation in abnormal returns. Given that the second period had already started, the information from the 2007 VE did not give any valuable new information to the investors.

[19] Change in VE is calculated as logarithmic VE 2005 - logarithmic VE 2006.

[Insert table 6 here]

For the last event evaluated, the 31/03/2009 we see positive significant results for change in verified emissions. So growing emissions values are positively evaluated by investors.

[Insert table 7 here]

These results show that for the first two events the market was more interested in over-allocation and valuing the amount of VE against allocated permits. This was the new information that could not be included in the stock prices before. After the first year the absolute amount of VE and the change in VE were the main influence factors. This is most probably because of the pending NAP II. So firms with higher VE (especially if high VE in 2005 were confirmed by the 2006 values) were supposed to get a more generous allocation in the second period. If this coherence actually was the reason for abnormal returns, then the EU ETS had wrong incentives for the firms, as higher emissions were seen as positive. The event at the end of period I did not include any relevant new information for the investors, especially as the second period had already started. For the first event of period II then growth in verified emissions were positively valuated by investors.

7 Conclusion

We investigate the impact of VE announcement on stock returns and find a significant cumulated negative impact for the VE of 2005 and a partly significantly positive one for VE 2007.

From the cross sectional analysis we find that over-allocation was the main influence factor for 2006 events. Market participants updated their expectations when they learned about the allocation of the first period.

In 2007 then VE were the explaining factor for individual abnormal returns. Higher VE caused positive abnormal returns. Most possibly this was because of the pending NAP II, where VE 2005 and VE 2006 served as a base for permit allocation for 2008-2012. So higher emissions in 2006 would not only indicate higher allocations for the second period, but it might also be a hint for not yet used abatement potentials.

For the event in 2008 VE did not show any impact on individual abnormal returns. As the second period had already started, no valuable new information could be gained from the announcement in May 2008.

The first event of the second period supports the findings from the 2006 results seeing higher verified emissions as a cause for positive abnormal returns in the cross sectional analysis. Therefore we conclude that the pressure on the firms covered by the EU ETS was not considered as very high but investors rather valuated the freely allocated permits as an additional asset. The ongoing change in the allocation procedure (towards full auctioning) is therefore supported by our analysis.

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Table 1: Event study results

Window	[-3,3]	[-3,1]	[-1,1]	[-1,3]	[0]
Panel A: 25/04/2006 (59 firms)					
ascar	−0.07	−0.15	−0.15	−0.06	−0.12
t_{AB}	−0.39	−0.89	−0.94	−0.32	−0.90
p-value	0.70	0.37	0.35	0.75	0.37
Panel B: 15/05/2006 (53 firms)					
ascar	−0.43	−0.40	−0.49	−0.49	−0.32
t_{AB}	−2.50	−2.53	−2.87	−2.78	−1.99
p-value	0.01	0.01	0.00	0.01	0.05
Panel C: 02/04/2007 (60 firms)					
ascar	0.05	0.15	0.23	0.10	0.01
t_{AB}	0.35	1.11	1.34	0.56	0.03
p-value	0.72	0.27	0.18	0.58	0.98
Panel D: 08/05/2007 (45 firms)					
ascar	−0.15	−0.12	−0.11	−0.15	0.02
t_{AB}	−0.91	−0.80	−0.67	−0.83	0.10
p-value	0.36	0.42	0.50	0.41	0.92
Panel E: 28/05/2008 (57 firms)					
ascar	0.22	0.25	0.27	0.22	0.29
t_{AB}	1.48	1.71	1.64	1.33	1.85
p-value	0.14	0.09	0.10	0.18	0.06
Panel F: 31/03/2009 (54 firms)					
ascar	0.20	0.14	0.35	0.37	0.16
t_{AB}	1.24	0.91	2.26	2.19	0.92
p-value	0.21	0.36	0.02	0.03	0.36

Note: The Table shows estimation results for average scaled cumulated abnormal returns (*ascar*, see equation 4), the adjusted BMP statistic (t_{AB}) proposed by Kolari and Pynnönen (2010) and its p-value.

Table 2: Cross sectional results (25/04/2006)

Window	Constant	Sales	MtBv	VE	OA	VE/Sales	CD	$\overline{R}^2$	F
[-3,3]	-0.490	-0.015	-0.022	0.228	0.379		0.146	-0.056	0.808
	-0.250	0.169	-0.022		0.352	0.178	-0.265	-0.044	2.067
	0.063			-0.061				-0.018	0.019
	-0.116				0.397			-0.001	1.881
	0.569					0.053		-0.009	0.430
[-3,1]	-0.674	0.031	-0.012	-0.003	0.803**		0.026	0.000	1.393
	-0.602	0.006	-0.012		0.792***	-0.028	-0.084	0.002	1.424
	0.720			-0.365				-0.007	0.904
	-0.230				0.787***			0.063	8.413***
	0.124					0.024		-0.016	0.106
[-1,1]	-0.540	-0.004	-0.027	0.163	0.677*		0.052	0.012	1.035
	-0.465	0.148	-0.027		0.669*	0.150	-0.082	0.014	1.066
	0.488			-0.267				-0.012	0.319
	-0.217				0.693**			0.047	5.054*
	0.555					0.059		-0.005	0.775
[-1,3]	-0.370	-0.040	-0.031	0.344	0.234		0.172	-0.039	5.635**
	-0.113	0.264	-0.031		0.209	0.299	-0.279	-0.027	1.611
	-0.159			0.038				-0.018	0.006
	-0.088				0.275			-0.010	0.824
	0.853					0.075		-0.001	0.776
[0]	0.398	-0.018	0.006	-0.151	0.436		-0.002	-0.036	0.790
	0.473	-0.205	0.006		0.417	-0.193	-0.097	-0.031	0.996
	0.990			-0.466				0.008	1.764
	-0.182				0.510			0.034	1.767
	0.681					0.067		0.008	1.730

Note: The table shows regression results for the following models:

$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_3 \cdot \text{VE}_i + b_4 \cdot \text{OA}_i + b_6 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_4 \cdot \text{OA}_i + b_5 \cdot \text{VE/Sales}_i + b_6 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_3 \cdot \text{VE}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_4 \cdot \text{OA}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_5 \cdot \text{VE/Sales}_i + e_i,$$

where $scar_i^{t_1,t_2}$ are the standardized cumulated abnormal returns estimated in the event study (see equation 3) of firm i. Sales_i is the logarithm of firm i's sales in the previous year, MtBv_i is the logarithm of the Market to Book value of firm i based on the preceding December, VE_i are the logarithmic verified emission which are expected to be published at the time the event takes place, OA_i is the over-allocation with respect to the published VE, VE/Sales_i is VE divided by sales in logarithmic form and CD_i is a country dummy which is one for firms located in Denmark or the UK. Observations where one of the dependent variables are missing or where VE or allowances are zero are dropped. We report OLS coefficients, the adjusted R^2 measure ($\overline{R}^2$) and the F-statistic which tests the null hypothesis that all dependent variables, excluding the constant, are jointly zero. We report significance levels for 1 % (***), 5 % (**) and 10 % (*). All inferences are based on a wild bootstrap procedure (see Flachaire (2005) for details).

Table 3: Cross sectional results (15/05/2006)

Window	Constant	Sales	MtBv	VE	OA	VE/Sales	CD	$\overline{R}^2$	F
[-3,3]	1.769	-0.069	-0.025	-0.094	-0.867		0.321	0.059	2.348
	2.006*	-0.167**	-0.038		-0.821**	-0.093*	-0.049	0.032	1.901
	0.504			-0.077*				0.029	2.113
	-0.373				-0.396			-0.003	1.292
	-0.496					-0.028		-0.014	0.250
[-3,1]	1.264	-0.074	-0.011	-0.045	-0.497		0.143	-0.044	0.974
	1.365	-0.121	-0.020		-0.464	-0.043	0.030	-0.050	0.791
	0.144			-0.046				0.000	1.202
	-0.379				-0.231			-0.013	0.315
	-0.437					-0.011		-0.019	0.049
[-1,1]	1.352	-0.107	0.008	-0.020	-0.339		-0.013	-0.066	0.602
	1.329	-0.129	-0.001		-0.303	-0.015	0.156	-0.061	0.601
	-0.079			-0.033				-0.011	0.547
	-0.457				-0.119			-0.018	0.090
	-0.427					0.016		-0.018	0.118
[-1,3]	1.876*	-0.094	-0.013	-0.079	-0.775**		0.230	0.022	1.830
	2.040*	-0.176**	-0.025		-0.728*	-0.077	0.024	0.009	1.667
	0.375			-0.070				0.019	1.757
	-0.423				-0.321			-0.009	0.745
	-0.484					-0.008		-0.019	0.030
[0]	1.932*	-0.112	-0.030	-0.037	-0.211		-0.099	-0.027	0.759
	1.859*	-0.147**	-0.026		-0.225	-0.037	0.016	-0.030	0.795
	0.310			-0.051				0.004	1.166
	-0.298				0.028			-0.020	0.004
	-0.284					0.004		-0.020	0.006

Note: The table shows regression results for the following models:

$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_3 \cdot \text{VE}_i + b_4 \cdot \text{OA}_i + b_6 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_4 \cdot \text{OA}_i + b_5 \cdot \text{VE/Sales}_i + b_6 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_3 \cdot \text{VE}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_4 \cdot \text{OA}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_5 \cdot \text{VE/Sales}_i + e_i,$$

where $scar_i^{t_1,t_2}$ are the standardized cumulated abnormal returns estimated in the event study (see equation 3) of firm i. Sales_i is the logarithm of firm i's sales in the previous year, MtBv_i is the logarithm of the Market to Book value of firm i based on the preceding December, VE_i are the logarithmic verified emission which are expected to be published at the time the event takes place, OA_i is the over-allocation with respect to the published VE, VE/Sales_i is VE divided by sales in logarithmic form and CD_i is a country dummy which is one for firms located in Denmark or the UK. Observations where one of the dependent variables are missing or where VE or allowances are zero are dropped. We report OLS coefficients, the adjusted R^2 measure ($\overline{R}^2$) and the F-statistic which tests the null hypothesis that all dependent variables, excluding the constant, are jointly zero. We report significance levels for 1 % (***), 5 % (**) and 10 % (*). All inferences are based on a wild bootstrap procedure (see Flachaire (2005) for details).

Table 4: Cross sectional results (02/04/2007)

Window	Constant	Sales	MtBv	VE	OA	ChVE	VE/Sales	CD	$\overline{R}^2$	F
[-3,3]	-1.631*	0.065	-0.035	0.063*	-0.051	-0.016		0.144	0.050	0.945
	-1.631*	0.129**	-0.035		-0.051	-0.016	0.063*	0.144	0.050	0.945
	-0.936***			0.087***					0.109	7.207***
	0.137				-0.310				0.007	1.621
	0.094					-0.088			-0.016	0.548
	0.284						0.067**		0.045	4.007*
[-3,1]	-1.532*	0.083	-0.045	0.040	0.050	0.104		0.230	0.016	0.551
	-1.532*	0.123*	-0.045		0.050	0.104	0.040	0.230	0.016	0.551
	-0.426			0.052					0.032	1.959
	0.204				-0.097				-0.016	0.178
	0.188					0.045			-0.018	0.056
	0.251						0.021		-0.011	0.355
[-1,1]	-0.282	-0.029	-0.054	0.082	-0.066	0.184		0.333	-0.026	0.716
	-0.282	0.052	-0.054		-0.066	0.184	0.082	0.333	-0.026	0.716
	-0.421			0.061					0.022	1.522
	0.340				-0.284				-0.005	1.097
	0.297					0.092			-0.017	0.225
	0.012						0.002		0.025	1.645
[-1,3]	-0.612	-0.028	-0.038	0.098*	-0.156	-0.021		0.200	0.027	1.254
	-0.612	0.069	-0.038		-0.156	0.021	0.098*	0.200	0.027	1.254
	-0.996**			0.097***					0.096	6.908**
	0.226				-0.483**				0.026	3.498
	0.157					-0.076			-0.017	0.325
	0.474						0.111**		0.107	5.006*
[0]	1.172	-0.132	-0.025	0.076	0.226	0.214		-0.058	-0.042	1.266
	1.172	-0.056	-0.025		0.226	0.214	0.076	-0.058	-0.042	1.266
	-0.216			0.022					-0.014	0.251
	0.033				0.083				-0.018	0.121
	0.040					0.232			-0.010	1.709
	0.234						0.065		0.011	0.942

Note: The table shows regression results for the following models:

$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_3 \cdot \text{VE}_i + b_4 \cdot \text{OA}_i + b_5 \cdot \text{ChVE}_i + b_7 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_4 \cdot \text{OA}_i + b_6 \cdot \text{VE/Sales}_i + b_7 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_3 \cdot \text{VE}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_4 \cdot \text{OA}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_5 \cdot \text{ChVE}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_6 \cdot \text{VE/Sales}_i + e_i,$$

where $scar_i^{t_1,t_2}$ are the standardized cumulated abnormal returns estimated in the event study (see equation 3) of firm i. Sales_i is the logarithm of firm i's sales in the previous year, MtBv_i is the logarithm of the Market to Book value of firm i based on the preceding December, VE_i are the logarithmic verified emission which are expected to be published at the time the event takes place, OA_i is the over-allocation with respect to the published VE, ChVE_i is the change in logarithmic VE, VE/Sales_i is VE divided by sales in logarithmic form and CD_i is a country dummy which is one for firms located in Denmark or the UK. Observations where one of the dependent variables are missing or where VE or allowances are zero are dropped. We report OLS coefficients, the adjusted R^2 measure ($\overline{R}^2$) and the F-statistic which tests the null hypothesis that all dependent variables, excluding the constant, are jointly zero. We report significance levels for 1 % (***), 5 % (**) and 10 % (*). All inferences are based on a wild bootstrap procedure (see Flachaire (2005) for details).

Table 5: Cross sectional results (08/05/2007)

Window	Constant	Sales	MtBv	VE	OA	ChVE	VE/Sales	CD	$\overline{R}^2$	F
[-3,3]	1.992	-0.125	0.003	0.011	-0.434	-0.236***		-0.607*	0.149	1.934
	1.992	-0.114	0.003		-0.434	-0.236***	0.011	-0.607*	0.149	1.934
	-0.134			-0.003					-0.028	0.003
	-0.119				-0.346				0.006	0.861
	-0.172					-0.146*			0.039	0.230
	-0.082						0.024		-0.019	0.154
[-3,1]	2.010*	-0.092	0.036	-0.028	-0.572*	-0.176**		-0.806**	0.251	1.822
	2.010*	-0.120	0.036		-0.572*	-0.176**	-0.028	-0.806**	0.251	1.822
	-0.111			-0.004					-0.027	0.010
	-0.103				-0.414				0.042	1.410
	-0.163					-0.106			0.022	0.668
	-0.102						0.017		-0.022	0.099
[-1,1]	2.094**	-0.159	0.025	0.022	-0.426	-0.043		-0.329	0.199	2.683
	2.094**	-0.137	0.025		-0.426	-0.043	0.022	-0.329	0.033	0.956
	-0.505			0.032					-0.010	0.418
	-0.093				-0.434				0.039	1.229
	-0.149					0.053			-0.018	0.008
	0.060						0.062		0.045	2.273
[-1,3]	1.973	-0.178	-0.013	0.057	-0.275	-0.140**		-0.179	0.007	1.305
	1.973	-0.121	-0.013		-0.275	-0.140**	0.057	-0.179	0.007	1.305
	-0.435			0.025					-0.020	0.450
	-0.110				-0.332				0.001	0.788
	-0.156					-0.028			-0.026	0.002
	0.050						0.060		0.021	2.464
[0]	0.413	-0.042	-0.021	0.003	0.017	0.169		0.275	-0.075	0.110
	0.413	-0.040	-0.021		0.017	0.169	0.003	0.275	-0.075	0.110
	-0.281			0.023					-0.020	0.087
	-0.015				-0.085				-0.026	0.040
	-0.004					0.168			0.065	0.037
	0.112						0.040		-0.002	0.266

Note: The table shows regression results for the following models:

$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_3 \cdot \text{VE}_i + b_4 \cdot \text{OA}_i + b_5 \cdot \text{ChVE}_i + b_7 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_4 \cdot \text{OA}_i + b_6 \cdot \text{VE/Sales}_i + b_7 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_3 \cdot \text{VE}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_4 \cdot \text{OA}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_5 \cdot \text{ChVE}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_6 \cdot \text{VE/Sales}_i + e_i,$$

where $scar_i^{t_1,t_2}$ are the standardized cumulated abnormal returns estimated in the event study (see equation 3) of firm i. Sales_i is the logarithm of firm i's sales in the previous year, MtBv_i is the logarithm of the Market to Book value of firm i based on the preceding December, VE_i are the logarithmic verified emission which are expected to be published at the time the event takes place, OA_i is the over-allocation with respect to the published VE, ChVE_i is the change in logarithmic VE, VE/Sales_i is VE divided by sales in logarithmic form and CD_i is a country dummy which is one for firms located in Denmark or the UK. Observations where one of the dependent variables are missing or where VE or allowances are zero are dropped. We report OLS coefficients, the adjusted R^2 measure ($\overline{R}^2$) and the F-statistic which tests the null hypothesis that all dependent variables, excluding the constant, are jointly zero. We report significance levels for 1 % (***), 5 % (**) and 10 % (*). All inferences are based on a wild bootstrap procedure (see Flachaire (2005) for details).

Table 6: Cross sectional results (28/05/2008)

Window	Constant	Sales	MtBv	VE	OA	ChVE	VE/Sales	CD	$\overline{R}^2$	F
[-3,3]	0.901	-0.014	-0.237	-0.033	-0.343	0.098		0.363	0.019	0.729
	0.901	-0.047	-0.237		-0.343	0.098	-0.033	0.363	0.019	0.729
	1.099			-0.077					0.033	1.870
	0.265				-0.158				-0.017	0.092
	0.217					0.112			0.008	0.233
	-0.007						-0.067		0.016	1.068
[-3,1]	-0.944	0.120	-0.269	-0.047	-0.435	0.078		0.554**	0.181	1.972
	-0.944	0.072	-0.269		-0.435	0.078	-0.047	0.554	0.181	1.972
	1.086			-0.071					0.032	1.822
	0.321				-0.197				-0.013	0.138
	0.265					0.120			0.017	0.510
	-0.128						-0.114**		0.100	5.215
[-1,1]	-0.865	0.113	-0.295	-0.047	-0.634	0.142		0.670***	0.199	2.683
	-0.865	0.065	-0.295		-0.634	0.142	-0.047	0.670***	0.199	2.683
	1.170			-0.078					0.026	1.410
	0.370				-0.416				0.003	0.489
	0.267					0.183			0.045	0.575
	-0.132						-0.119*		0.077	3.085
[-1,3]	1.336*	-0.049	-0.239	-0.028	-0.461	0.147		0.395	0.031	2.200
	1.336	-0.077	-0.239		-0.461	0.147	-0.028	0.395	0.031	2.200
	1.119			-0.080					0.025	1.473
	0.279				-0.310				-0.009	0.305
	0.198					0.153			0.021	0.274
	0.019						-0.058		0.001	0.488
[0]	-0.400	0.054	-0.197	-0.017	-0.083	0.148		0.412	0.019	1.781
	-0.400	0.037	-0.197		-0.083	0.148	-0.017	0.412	0.019	1.781
	0.810			-0.049					0.000	0.811
	0.250				0.093				-0.019	0.044
	0.228					0.181			0.050	5.757
	-0.016						-0.077		0.025	1.767

Note: The table shows regression results for the following models:

$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_3 \cdot \text{VE}_i + b_4 \cdot \text{OA}_i + b_5 \cdot \text{ChVE}_i + b_7 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_4 \cdot \text{OA}_i + b_6 \cdot \text{VE/Sales}_i + b_7 \cdot \text{CD}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_3 \cdot \text{VE}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_4 \cdot \text{OA}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_5 \cdot \text{ChVE}_i + e_i$$
$$scar_i^{t_1,t_2} = a + b_6 \cdot \text{VE/Sales}_i + e_i,$$

where $scar_i^{t_1,t_2}$ are the standardized cumulated abnormal returns estimated in the event study (see equation 3) of firm i. Sales_i is the logarithm of firm i's sales in the previous year, MtBv_i is the logarithm of the Market to Book value of firm i based on the preceding December, VE_i are the logarithmic verified emission which are expected to be published at the time the event takes place, OA_i is the over-allocation with respect to the published VE, ChVE_i is the change in logarithmic VE, VE/Sales_i is VE divided by sales in logarithmic form and CD_i is a country dummy which is one for firms located in Denmark or the UK. Observations where one of the dependent variables are missing or where VE or allowances are zero are dropped. We report OLS coefficients, the adjusted R^2 measure ($\overline{R}^2$) and the F-statistic which tests the null hypothesis that all dependent variables, excluding the constant, are jointly zero. We report significance levels for 1 % ($***$), 5 % ($**$) and 10 % ($*$). All inferences are based on a wild bootstrap procedure (see Flachaire (2005) for details).

Table 7: Cross sectional results (31/03/2009)

Window	Constant	Sales	MtBv	VE	OA	ChVE	VE/Sales	CD	$\overline{R}^2$	F
[-3,3]	-1.251	-0.008	0.099	0.701	0.274	0.243		-0.569	-0.052	0.594
	-1.251	0.693	0.099		0.274	0.243	0.701	-0.569	-0.052	0.594
	-0.594			0.342					-0.015	0.275
	0.217				0.043				-0.022	0.022
	0.253					0.136			-0.012	0.221
	0.215						-0.001		-0.023	0.000
[-3,1]	-0.254	-0.056	0.105*	0.604	0.151	0.282*		-0.797***	0.116	1.469
	-0.254	0.548	0.105*		0.151	0.282*	0.604	-0.797***	0.116	1.469
	-0.846			0.416					-0.011	0.475
	0.150				-0.063				-0.022	0.048
	0.183					0.153			-0.001	3.739
	0.852						0.059		-0.003	0.638
[-1,1]	1.611	0.082	0.074	-0.989	-0.287	0.251**		-0.363	-0.014	1.279
	1.611	-0.907	0.074		-0.287	0.251*	-0.989	-0.363	-0.014	1.279
	2.252*			-0.807					0.027	1.989
	0.335				-0.065				-0.022	0.077
	0.404					0.173			0.004	1.545
	-0.438						-0.064		0.002	2.741
[-1,3]	0.019	0.111	0.071	-0.542	-0.049	0.199		-0.158	-0.076	0.531
	0.019	-0.431	0.071		-0.049	0.199	-0.542	-0.158	-0.076	0.531
	1.897			-0.640					0.003	1.174
	0.368				0.065				-0.022	0.043
	0.431					0.142			-0.010	0.112
	-0.943						-0.110		0.038	3.563
[0]	0.708	0.068	0.071	-0.705	-0.397	0.200		-0.178	-0.038	0.627
	0.708	-0.637	0.071		-0.397	0.200	-0.705	-0.178	-0.038	0.627
	0.971			-0.369					-0.013	0.336
	0.116				-0.283				0.000	1.380
	0.056					0.106			-0.015	0.265
	-0.925*						-0.085*		0.021	3.233

Note: The table shows regression results for the following models:

$$
\begin{aligned}
scar_i^{t_1,t_2} &= a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_3 \cdot \text{VE}_i + b_4 \cdot \text{OA}_i + b_5 \cdot \text{ChVE}_i + b_7 \cdot \text{CD}_i + e_i \\
scar_i^{t_1,t_2} &= a + b_1 \cdot \text{Sales}_i + b_2 \cdot \text{MtBv}_i + b_4 \cdot \text{OA}_i + b_6 \cdot \text{VE/Sales}_i + b_7 \cdot \text{CD}_i + e_i \\
scar_i^{t_1,t_2} &= a + b_3 \cdot \text{VE}_i + e_i \\
scar_i^{t_1,t_2} &= a + b_4 \cdot \text{OA}_i + e_i \\
scar_i^{t_1,t_2} &= a + b_5 \cdot \text{ChVE}_i + e_i \\
scar_i^{t_1,t_2} &= a + b_6 \cdot \text{VE/Sales}_i + e_i,
\end{aligned}
$$

where $scar_i^{t_1,t_2}$ are the standardized cumulated abnormal returns estimated in the event study (see equation 3) of firm i. Sales_i is the logarithm of firm i's sales in the previous year, MtBv_i is the logarithm of the Market to Book value of firm i based on the preceding December, VE_i are the logarithmic verified emission which are expected to be published at the time the event takes place, OA_i is the over-allocation with respect to the published VE, ChVE_i is the change in logarithmic VE, VE/Sales_i is VE divided by sales in logarithmic form and CD_i is a country dummy which is one for firms located in Denmark or the UK. Observations where one of the dependent variables are missing or where VE or allowances are zero are dropped. We report OLS coefficients, the adjusted R^2 measure ($\overline{R}^2$) and the F-statistic which tests the null hypothesis that all dependent variables, excluding the constant, are jointly zero. We report significance levels for 1 % ($***$), 5 % ($**$) and 10 % ($*$). All inferences are based on a wild bootstrap procedure (see Flachaire (2005) for details).